COMPARISON OF TWO METHODS FOR CONTROLLING IN-VEHICLE EXPOSURE IN STUDIES OF ACUTE CARDIOPULMONARY EFFECTS OF TRAFFIC-RELATED AIR POLLUTANTS

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Background: Associations between traffic-related air pollutants (TRAPs) and acute cardiopulmonary outcomes may be confounded by psychological stress, noise, and other exposures. Laboratory-based exposure studies of the health effects of vehicle emissions can control these factors, but may differ in important ways from 'real-world' conditions. We compared two methods for controlling exposure to particulate TRAPs among volunteers during car rides simulating a rush-hour commute.
Methods: A total of 47 adult subjects were passengers during two 2-hr car rides, at least 1 week apart, in a Ford Taurus sedan. The route was primarily on the New Jersey Turnpike, a major highway with heavy diesel truck traffic. Twenty subjects had one ride with the external air intake vent open, and one ride with the vent closed. Twenty-seven subjects wore a powered air-purifying respirator (PAPR) with the vent open during both rides, but with a high-efficiency particulate air (HEPA) filter in place in the PAPR during only one of the car rides. All subjects were blinded to the exposure conditions, which were administered in random order. Measurements in the vehicle and inside the respirator facepiece included total particle count and particulate matter less than 2.5 μm ($PM_{2.5}$). Subjects reported levels of stress by questionnaire before, during, and after the rides.
Results: Closing the vent reduced in-vehicle mean particle number and $PM_{2.5}$ concentrations by 53% and 29%, respectively. In contrast, the PAPR with filter in place reduced mean particle number and $PM_{2.5}$ inside the respirator facepiece by greater than 99.9% and 83%, respectively. Changes in stress levels were similar comparing subjects under the PAPR filter/no-filter conditions to subjects under the vent open/closed conditions.
Conclusions: The PAPR was an efficient, well-tolerated, and cost-effective method for controlling particle exposure in blinded, crossover studies of acute health effects of exposure to particulate TRAPs.